Geophysical Research Abstracts
Vol. 17, EGU2015-10799, 2015
EGU General Assembly 2015

Effect of organic fertilizer and biochar application on soil macro-aggregate formation and organic carbon turnover

Dennis Grunwald, Michael Kaiser, and Bernard Ludwig
Department of Environmental Chemistry, University of Kassel, Nordbahnhofstr. 1a, 37213 Witzenhausen, Germany

Macro-aggregates are important for the organic matter dynamic and thus the productivity of sustainably managed soils. To date, less is known about the influence of biochar in comparison to other commonly used organic soil additives on the formation of macro-aggregates and organic carbon turnover. Here we aimed to analyze the effects of biochar applied individually and in combination with slurry versus the effects of the individual application of slurry and manure on macro-aggregate yield, the associated organic carbon concentration, and the organic carbon mineralization. For this, we crushed the macro-aggregate fraction (>250 μm) of two different soils that were then mixed with biochar (combustion temperature: 550˚C, feedstock: woodchips) and/or cattle-slurry or cattle-manure and incubated within a microcosm experiment at 5˚C, 15˚C, and 25˚C. We monitored the CO_2 evolution during the incubation experiment. After four and eight weeks, we determined the dry mass and the carbon concentration of the newly formed macro-aggregates (>250 μm) and the microbial biomass carbon concentration. Carbon mineralization was modelled assuming first-order kinetics and using a rate modifying factor for the temperature (taken from the RothC-26.3 model). Two pools were considered (mineralization of the native organic matter from the control soils and mineralization of the substrates added) in each treatment and the models were calibrated to the C mineralization data at 25˚C, whereas the data for 15˚C and 5˚C were used for validation. Independent from the incubation temperature and the duration of the experiment, the individual application of biochar did not show significant effects on the macro-aggregate yield, the associated carbon concentration, or the CO_2 emission rate compared to the control sample receiving no amendments. For the application of biochar in combination with slurry, we observed only for the 15˚C treatment higher CO_2 emission rates in combination with higher macro-aggregate yields and microbial biomass carbon concentrations compared to the control sample. Among the analyzed treatments, the individual application of slurry resulted at 15˚C in the largest increase in the macro-aggregate yield and associated carbon concentration compared to the control sample. However, this did not coincide with respective differences regarding the microbial biomass and the CO_2 emission rate. The CO_2 emissions for the control and biochar treatments were well estimated by the chosen model approach indicating a strong positive temperature influence on the C mineralization kinetic. The CO_2 emissions in the treatments with application of slurry (with and without biochar) and manure were well to satisfactorily described (25˚C) and estimated (15˚C and 5˚C). No adjustment of maximum mineralizable C amounts or rate constants were required at the different temperatures, indicating the usefulness of the rate-modifying factor for temperature for the different amendments. Our results further suggest that the biochar studied here is only beneficial for soil macro-aggregate formation if applied in combination with a further organic additive such as slurry. The formation of macro-aggregates seems to be influenced by the temperature with the largest positive effect observed here at 15˚C compared to 5˚C and 25˚C incubation temperature.